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(54) FERTILISANT/OUVREUR DE FEVES DE SOYA (FOFS)
(54) FERTILIZER/SOYBEAN OPENER (FSO)

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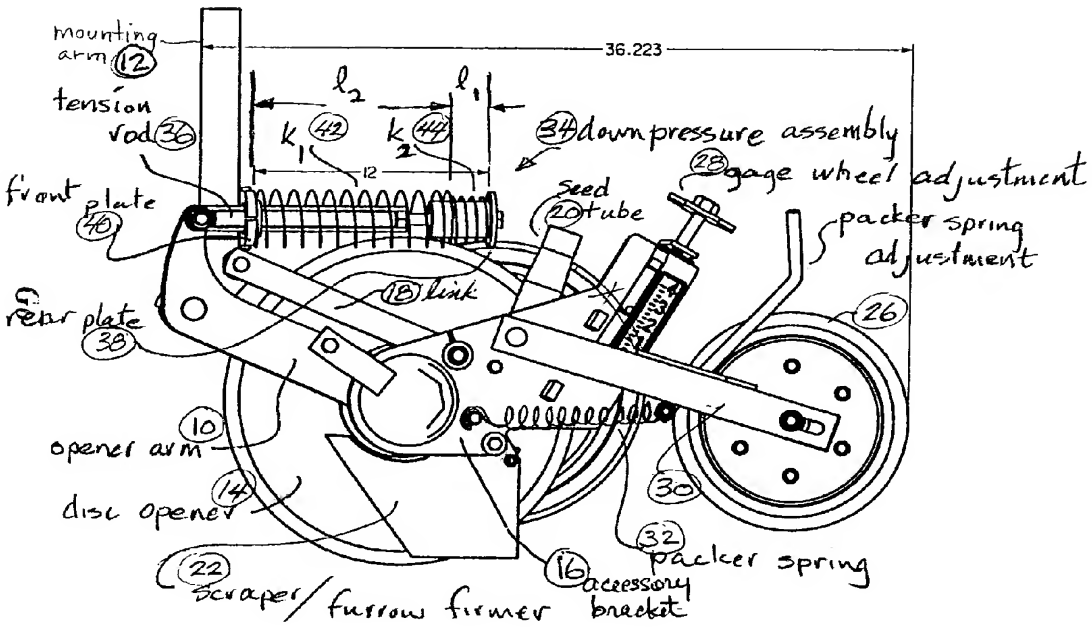


FERTILIZER/SOYBEAN OPENER (FSO)

This invention relates to a single disk ground opener unit employing dual range downpressure, an improved disc scraper mounting and a packer wheel angle adjustment each of which will be described in detail below.

FSO Dual Range Downpressure

This invention is for adjustment of downpressure to the FSO cutting disc opener. The packing wheel is not the depth gage wheel and pressure to the packing wheel is adjusted separately. The adjustment allows the opener assembly to be set for different soil conditions ranging from soft to firm.

Deere patent US 5,727,638 shows apparatus with similar objectives but different operation. The Deere apparatus has a downpressure arrangement which is either engaged, or not engaged, and has only one range of operation corresponding to the force produced by a single spring having a single spring constant. It is conceivable that a single spring may have a construction giving rise to multiple spring constants if the coil pitch, or coil diameter, was varied within the spring, however this is not known to be used in agriculture as it is known in automotive and motorcycle applications.

In addition to having 2 ranges of downpressure, applicants' downpressure assembly is arranged so that downpressure can be set differently between individual opener assemblies on an implement. An implement is commonly supported by wheels which bear much of the weight of the implement and which depress and pack the soil over which they travel. Depending on the desired spacing for which the opener assemblies are set on the implement, it is sometimes necessary for an opener assembly to plant into the soil which has been packed by the implement wheels. It is desirable for such an opener to apply more pressure to the opener disc to penetrate the packed soil to the proper planting depth. In the Deere assembly, the biasing element comes out of contact with the opener which pivots downwardly to areas which are lower than the average soil elevation. With applicants'

arrangement, the tension rod of the downpressure assembly can be adjusted accordingly, and moreso, for increased pressure.

Applicants' invention provides a plurality of springs having different spring constants in series in a downpressure assembly to bias a planting tool toward the ground. Dual or multiple ranges of downpressure are selectable by setting the amount of precompression of the assembly. The assembly allows the planting tool to pivot relative to the implement frame to follow contours of the ground while being biased toward the ground. The working position of the tool is maintained by a gage wheel adjacent a disc furrow opener which also acts as a cleaning mechanism. For loose soil conditions it is desirable to apply little downpressure so that the gage wheel is not pressed too deeply into the soil and otherwise causing rutting and plowing action and resulting in poor seed depth control. For firm soil conditions it is desirable to have a setting for more downpressure which can be selected for these various firmer soil conditions. The assembly is made compact by having multiple springs with multiple spring constants to effect a rapid and significantly broad change in pressure setting with a minimal displacement in the precompression setting. The invention provides springs with different wire diameter, offering a greater differential between downpressure ranges than can be achieved by varying the spring coil diameter or coil pitch. The spring sections having different wire diameter are made in separate pieces due to present practical manufacturing limits.

The preferred form of the invention thus includes a biasing assembly having 2 springs of different spring constants in series.

- the 1st spring absorbs a few inches of motion of the biasing assembly in a range of low biasing force
- the 2nd spring acts alone when the 1st spring is fully compressed to provide a 2nd range of higher biasing force

The biasing assembly has a working range and a setting range. Within the setting range there are at least 2 force ranges defined by the resultant spring

constant effective within each range.

Figs. 1.1, 1.2 and 1.3 show an opener assembly having an opener arm 10 pivotally mounted to a mounting arm 12. The opener arm 10 pivotally supports a disc furrow opener 14 and an accessory bracket 16. The accessory bracket 16 is further connected by a link 18 to the mounting arm 12 forming a parallel link arrangement with the opener arm 10 and maintaining a constant orientation of the accessory bracket 16 as the opener arm 10 pivots relative to the mounting arm 12. A seed tube 20, disc scraper 22, cleaner gage wheel 24, and closing wheel (packer) 26 are supported on the accessory bracket. The cleaning wheel 24 is mounted to an adjustment mechanism 28 and positioned adjacent one face of the disc opener 14 (Fig.1.3). The cleaning wheel 24 may be adjusted generally vertically via mechanism 28 and also acts as a depth control to limit the penetration of the disc opener 14 into the soil, as the wheel 24 rolls on the surface of the ground. The closing wheel 26 is pivotally connected to the accessory bracket 16 with a closing arm 30 and a spring 32 is connected between the closing arm 30 and accessory bracket 16 to bias the closing wheel 26 toward the ground.

A biasing assembly 34 is connected between the opener arm 10 and the mounting arm 12 to bias the opener arm toward the ground with the reaction being received through the mounting arm 12 through to the implement frame. The biasing assembly 34 consists of a tension rod 36 having 1st and 2nd ends. A rear plate 38 is secured to the 1st end and the 2nd end of the tension rod extends through a front plate 40. The front plate 40 is connected to the mounting arm. 1st and 2nd coil springs 42, 44 are fitted over the tension rod 36 and held between the front and rear plates. The 2nd end of the tension rod 36 is pivotally connected to the opener arm 10 so that movement of the opener arm 10 causes a displacement of the tension rod through the front plate 40. This changes the displacement between the 2 plates effecting a displacement of the springs 42,44. The springs resist compressive displacement and bias the opener

arm 10 toward the ground.

The 1st and 2nd springs 42, 44 are arranged in series between the plates 40, 38. The 1st and 2nd springs abut each other with their opposite ends abutting the rear and front plates respectively. A sleeve 46 attached to the rear plate extends through the inside of the 1st coil spring and partially inside the 2nd coil spring to keep the springs 42, 44 in abutting alignment. The means securing the rear plate to the tension rod includes threaded adjustable means to adjust the length of the tension rod 36 and set the precompression amount of the springs 42, 44, thus setting the range of downpressure for the working range of the planting tool.

An adjustment is thus provided on the biasing assembly 34 to set the amount of precompression in the spring assembly from a minimum pressure setting to a maximum pressure setting. At some point within the range of setting, the 1st spring 42 is fully compressed so that the biasing assembly operates only within the 2nd range of biasing force. A small amount of change to the precompression setting can significantly alter the working range biasing force, yet a large displacement remains available for large tripping motions that may be required in the working range.

A single spring would require a much larger change to the precompression adjustment for an equal change in biasing force, and then the working range displacement would be much more limited. Such an assembly with a single spring would also require an initial large spring length to accommodate the larger range of setting required. The larger range of setting also takes more time and effort.

In the 1st working range of the invention, both springs 42, 44 bear the load placed on the biasing assembly 34, but the spring constant K_2 of the 2nd spring 44 is much larger than K_1 of the 1st spring 42 so it is not significantly displaced during the first range of operation. It will however conveniently provide for full tripping action over obstacles. A second range of operation can

be selected by setting the spring precompression at some point at which the 1st spring 42 is fully compressed, in which case the biasing force is a function of only the 2nd spring 44.

FSO Scraper Mount

The FSO planting assembly is further arranged such that the opener disc is held at an angle from the forward direction of travel so that the disc has a leading face and a trailing face. The disc displaces soil laterally as it travels forward and opens a furrow following the trailing face. In wet conditions, soil tends to stick to the trailing face so it is common to provide a scraper to clean the disc. The scraper also acts to prevent loose soil from falling back into the furrow until the seed is properly placed into the furrow. The disc is subject to flexing as lateral forces are applied to the disc when opening the furrow. The scraper must be held close to the disc but not cause a braking action on the disc, therefor it must be allowed to flex and move with the disc's deflection.

Deere patent US 4,760,806 presents an angled disc opener having a seed tube on which a scraping element is attached. The seed tube is also pivotally mounted and biased toward the disc trailing face.

Applicants' invention includes a seed tube rigidly attached to the opener arm, a scraper mount means is provided on the seed tube, and the scraper mechanism is resiliently attached to the scraper mount for deflection with respect to the seed tube. This resilient means allows for adjustment about two axes and the flexibility about those axes in response to deflection of the disc helps to maintain the scraper edge parallel to the disc.

Referring particularly to Figs. 2.1, 2.2, 2.3 and 2.4 the disc scraper 122 is flexibly secured adjacent one surface of a disc opener 114 to scrape materials off the disc surface as it operates in the soil. It also prevents soil from falling back into the furrow before the seed can be properly placed, and contains the seed within the furrow until it settles to rest at the bottom. The scraper 122 must flex in response to contact with the disc 114 as the disc flexes in response to

varying forces on its surfaces as it operates in the soil. The disc opener is rotatably mounted to a planting tool opener arm 110. Ideally the disc 114 is oriented at an angle from the transverse so that as it is drawn through the soil it has a leading face and a trailing face 116 whereby the leading face displaces soil laterally and a furrow is opened following the trailing face. The scraper 122 is positioned adjacent the trailing face 116. The disc 114 is subject to deflections as the leading faces acts to displace the soil as noted above. The scraper is mounted such that it is able to flex when pressed on by the deflecting disc blade so that there is minimal reaction from the scraper which would otherwise cause a braking action on the disc, preventing it from rotating.

As noted above, the invention allows the scraper position with respect to the disc trailing surface 116 to be adjusted and also allows the scraper 122 to deflect from this position in response to the disc deflection. Two threaded fasteners 118 secure the scraper 122 to the scraper mount 120 with a resilient pad 124 of rubber or rubber-like material secured between them. A 1st adjustment axis is A-A defined as generally parallel to, but may be slightly offset from, a line between the two fasteners 118. A 2nd adjustment axis B-B is generally perpendicular to the 1st axis through a point intermediate the two fasteners. The scraper has an edge 126 at one end which is positioned along the disc trailing surface 116 for scraping, the 2nd end of the scraper 122 being held firm against the resilient pad 124 by the fasteners 118 which are somewhat intermediate of the two scraper ends. Most of the area of the resilient pad 124 is to one side of the 1st axis A-A and toward the 2nd end of the scraper 122. When both fasteners 118 are adjusted in generally equal portions, the scraper 122 is adjusted about the 1st axis A-A. (When both these fasteners 118 are tightened, resistance from the resilient pad at the 2nd end causes the scraper to press more closely to the disc at the 1st end) . When only one fastener 118 is tightened, resistance by the resilient pad near the other fastener causes the scraper to rotate slightly about the 2nd axis, changing the alignment between

the scraper edge 126 and the disc trailing surface. Ideally the scraper edge is held parallel to and against the disc trailing surface with a relatively small force and will flex with the trailing surface about the 1st and 2nd axes so that the edge 126 remains generally parallel to the disc surface where it contacts the disc. The resilient pad 124 provides enough force to hold the scraper in it's preferred position and so as not to allow soil to press between the scraper 122 and the disc 114 and force the scraper away from the disc which would otherwise cause soil to plug between the scraper and disc and possibly plug the seed tube as well.

Advantages vs Prior Art

A previous version of applicants' own implement used a somewhat similar means to adjust the angle of the scraper but this did not include a resilient means. The previous version had a bracket which supported the scraper and which included a three bolt pattern for adjusting the angle of the bracket. The bracket pivoted on the head of a fourth carriage bolt which became pressed against the opener arm when the three fasteners were tightened.

Disadvantages of this prior design were:

- adjustment of one fastener required corresponding readjustment of at least one of the others
- adjustment of the desired angle was complicated with the three fastener system
- the bracket often became permanently deformed if one fastener was tightened without first loosening the others
- the adjustment means did not provide resilient flexing to allow the scraper to flex in response to the disc blade

Advantages of Present Invention

- two fastener adjustment is simpler
- the resilient pad allows for adjustment by adjusting only one of the fasteners

- the resilient pad provides bias toward the blade while allowing flexing in response to the disc blade
- the resilient pad provides resilient bias about multiple axes to keep the scraper parallel to the blade while the blade flexes.

FSO Packer Angle Adjustment

The FSO planting assembly is further arranged to provide a means for adjusting the angle of the packer wheel.

Deere U.S.Patent 5,676,073 provides for lateral adjustment of the packer wheel position over the furrow but it does not incline the packer from the vertical and makes for very little change to the packer angle from forward alignment.

It is commonly known to operate a packer wheel at various angles or combination of angles inclined from vertical and angled from the forward direction but no prior art is known which allows adjustment of the packer inclination from vertical and no prior art is known which allows adjustment of the packer angle from the forward direction.

One embodiment of the present invention operates the packer wheel in two positions having the following angles:

1st position

- 0 degrees projected in the top view
- 0 degrees projected in the rear view

2nd position

- 4 degrees projected in the top view
- 6 degrees projected in the rear view

The range of angles for which the apparatus will work in the 2nd position may include holding either of the angles noted above at 0 degrees while varying only the other angle.

Referring to Figs. 1.1-1.3 and Figs. 3.1-3.4, the packer wheel 226 is secured to packer arm 230 at the rear end of packer arm 230, providing two

positions in which the packer wheel may operate. The position for the packer wheel 226 is selected dependent on soil conditions. The wheel 226 is rotatably mounted to a shaft 228 having a fastening means protruding through slot 236 and secured by a nut fastener 238 on the opposite side of arm 230. The packer wheel shaft 228 may be secured at the forward end of the slot 236 so the packer wheel 226 is held generally vertical and in alignment with the direction of travel (Figs. 3.1 and 3.3). The packer wheel shaft 228 may be secured in a 2nd position at the rearward end of the slot so that the packer wheel 226 is held at an angle inclined from the vertical and also angled from the direction of travel (Figs. 3.2 and 3.4). In the second position, the packer wheel 226 provides more aggressive lateral action to scrape soil over the furrow to close and pack the furrow (Fig. 3.4). This action is required in firmer soil conditions such as in no-till farming. In loose soil conditions, soil tends to fall back over the furrow without aggressive lateral action of the packer being required and it is more desirable for the packer to be more vertical and aligned to the direction of travel for optimum packing in that condition.

Tilled/Loose Soil

The packer wheel 226 is operated in a generally vertical position for the following advantages:

- the tire (on the packer wheel 226) will have a greater footprint and more floatation over the soft soil
- the tire shape is oriented optimally for packing on either side of the seed for good seed soil contact important to germination, but not excessively pack directly over the seed which hinders plant emergence
- in fields where the implement is not always operated in a straight line but must follow curves around areas of water or trees, the packer wheel will be skewed slightly to one side or the other of the furrow in which case the full width of the packer wheel acts on the soil so that part of it will ride over the furrow for packing

No-Till/Firm Soil

The second position at the rearward end of the slot causes the packer wheel to be held at an angle inclined to the vertical and from the direction of travel in order to gain the following advantages which become more important in firm soil conditions:

- the tire is oriented to laterally press the high ridged side of the furrow back over the furrow which would not otherwise be properly closed by only a vertical packing action or a by packing on either side of the seed trench as in the loose soil arrangement above
- the tire is oriented to operate more one an edge which reduces the packing area and therefor increases the pressure which is applied over the smaller area with no change in the total packing force

The slotted packer arm provides a quick and easy means to change the packer wheel for these different conditions.

CLAIMS:

1. A disc opener with dual range downpressure substantially as described.

2. A disc opener with improved disc scraper mounting substantially as described.

3. A disc opener with packer wheel angle adjustment substantially as described.

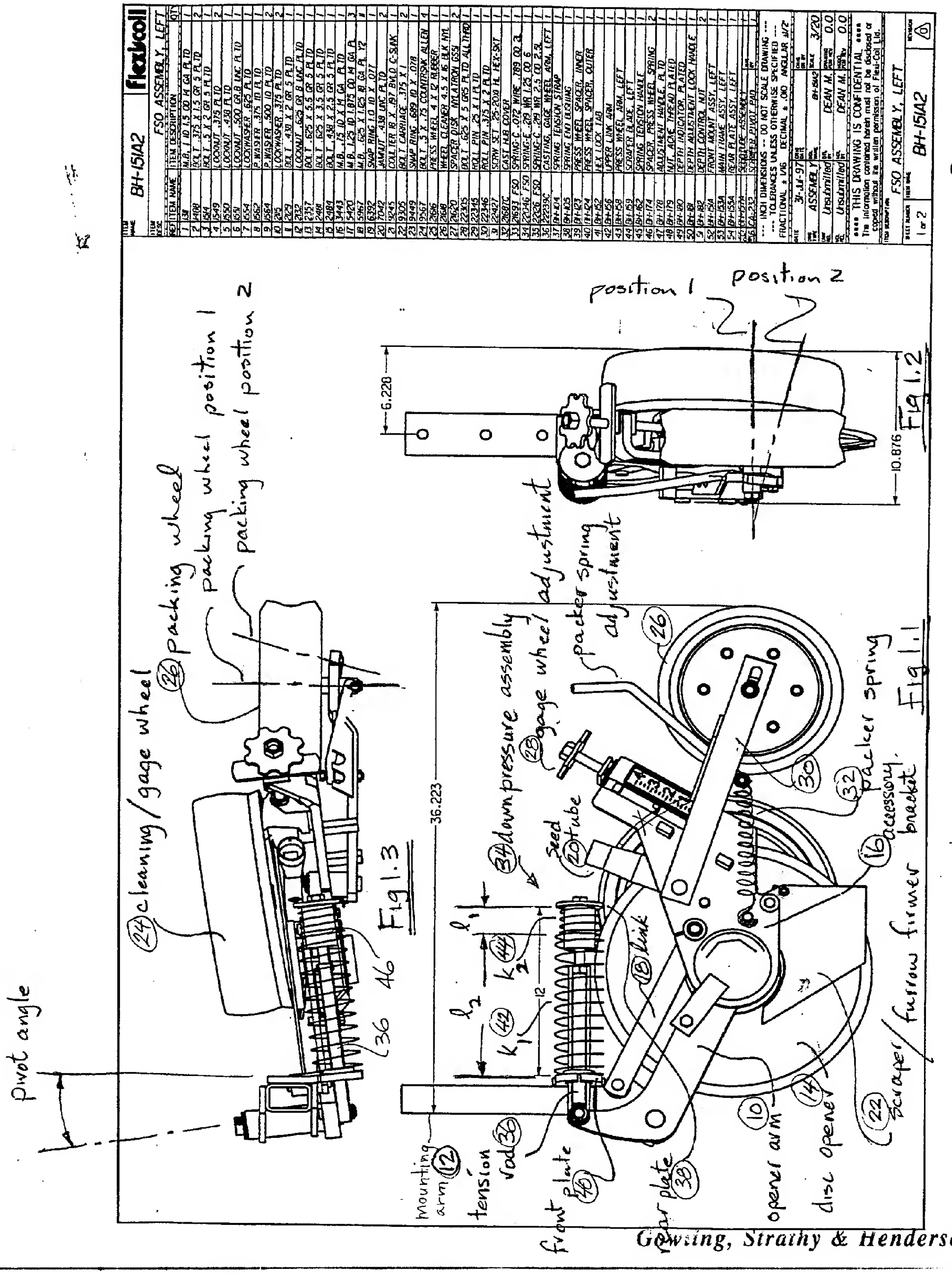

Flexi-coil
BH-151A2
FSO ASSEMBLY, LEFT
pivot angle
24 cleaning/gage wheel
26 packing wheel
packing wheel position 1
packing wheel position 2
36
46
Fig 1.3
36.223
34 down pressure assembly
seed 20 tube
28 gage wheel adjustment
packer spring adjustment
26
30
32 packer spring
16 accessory bracket
furrow firmer
22 scraper
14 disc opener
10 opener arm
38 rear plate
40 front plate
36 tension rod
12 mounting arm
18 link
Fig 1.1
6.228
10.876
position 1
position 2
Fig 1.2
Fig 1.1-1.3

FIG 2.1

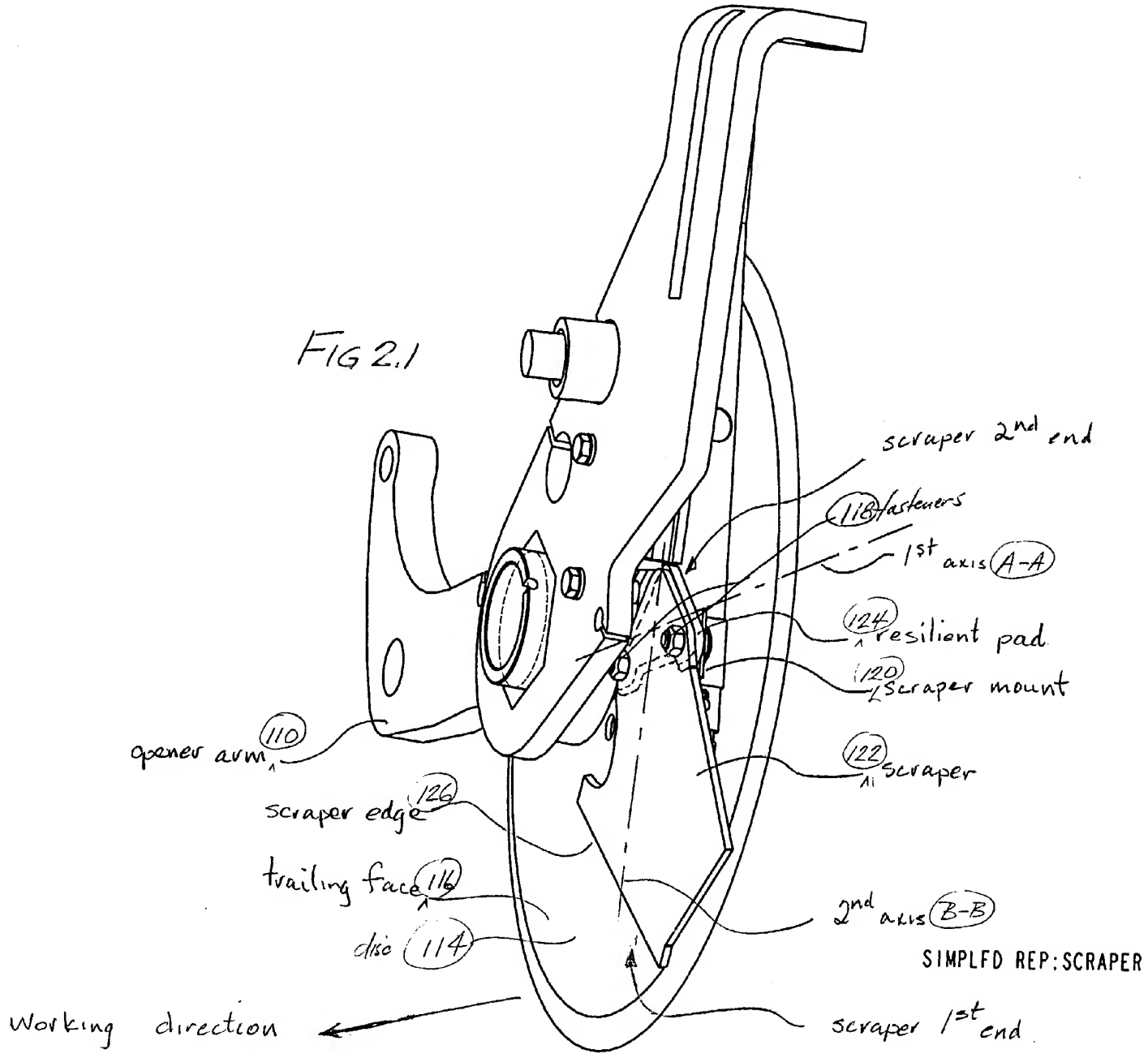
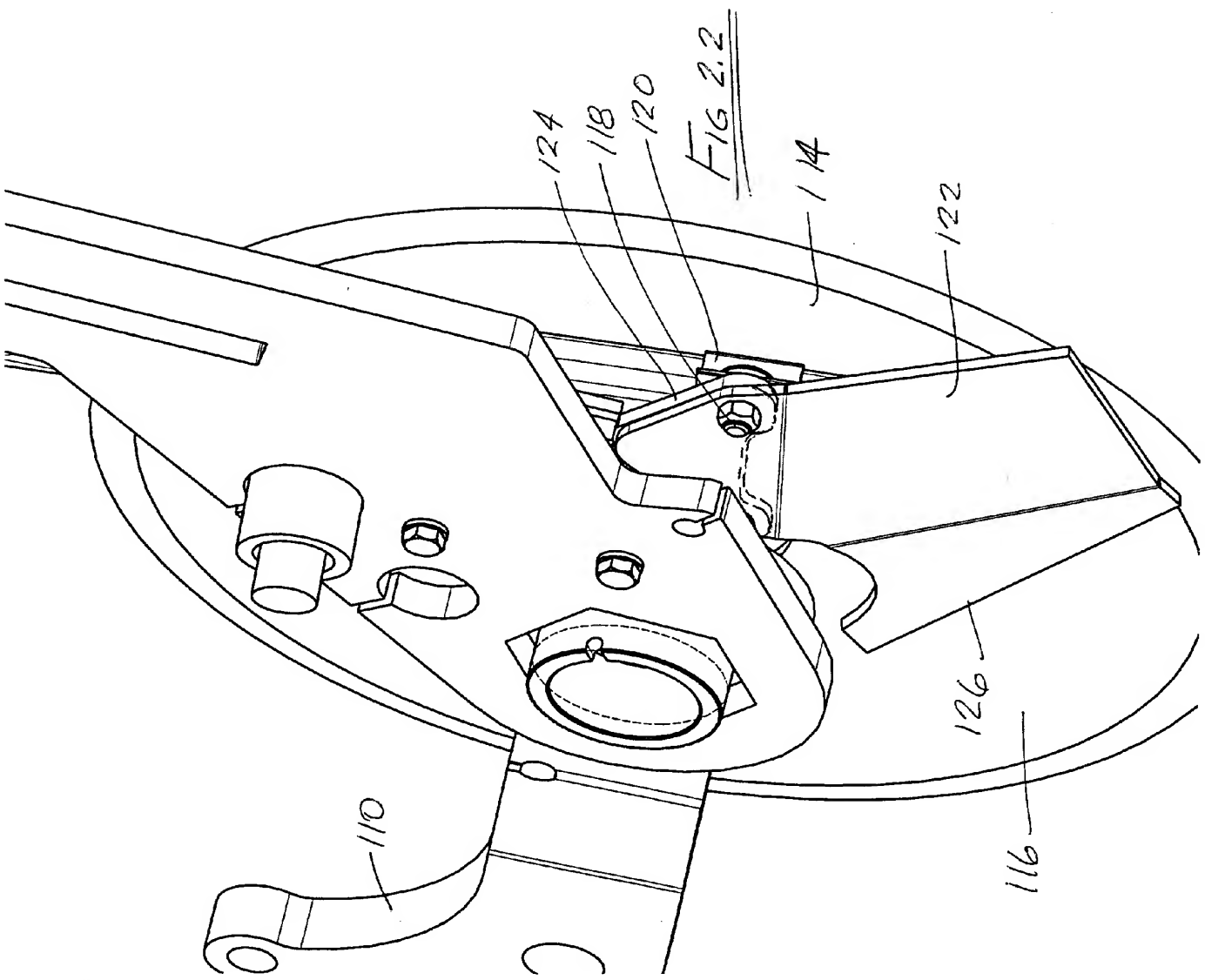


fig 2.1

SIMPLFD REP:SCRAPER

fig 2.2



SIMPLFD REP:SCRAPER

Fig 2.3

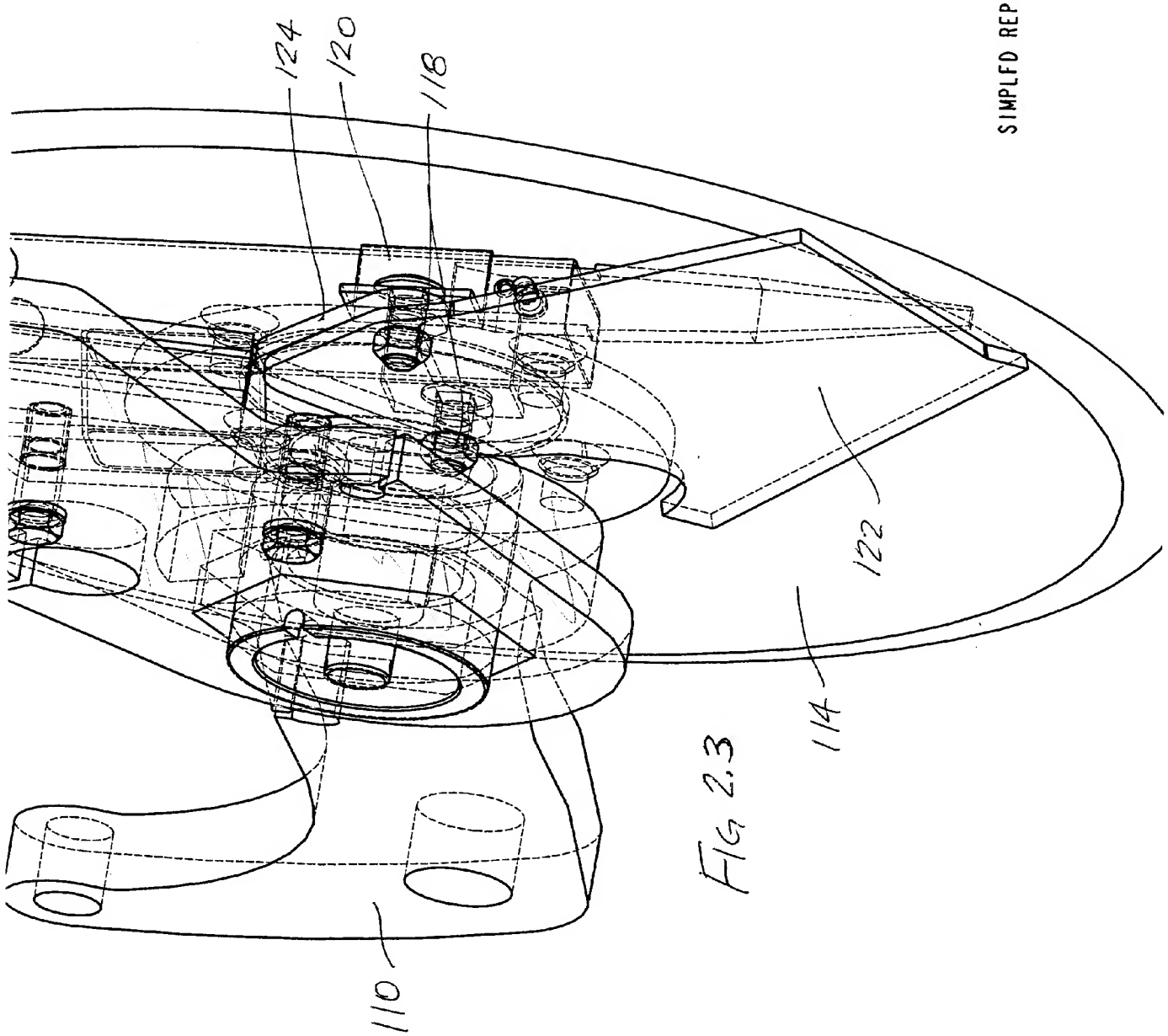


Fig 2.3

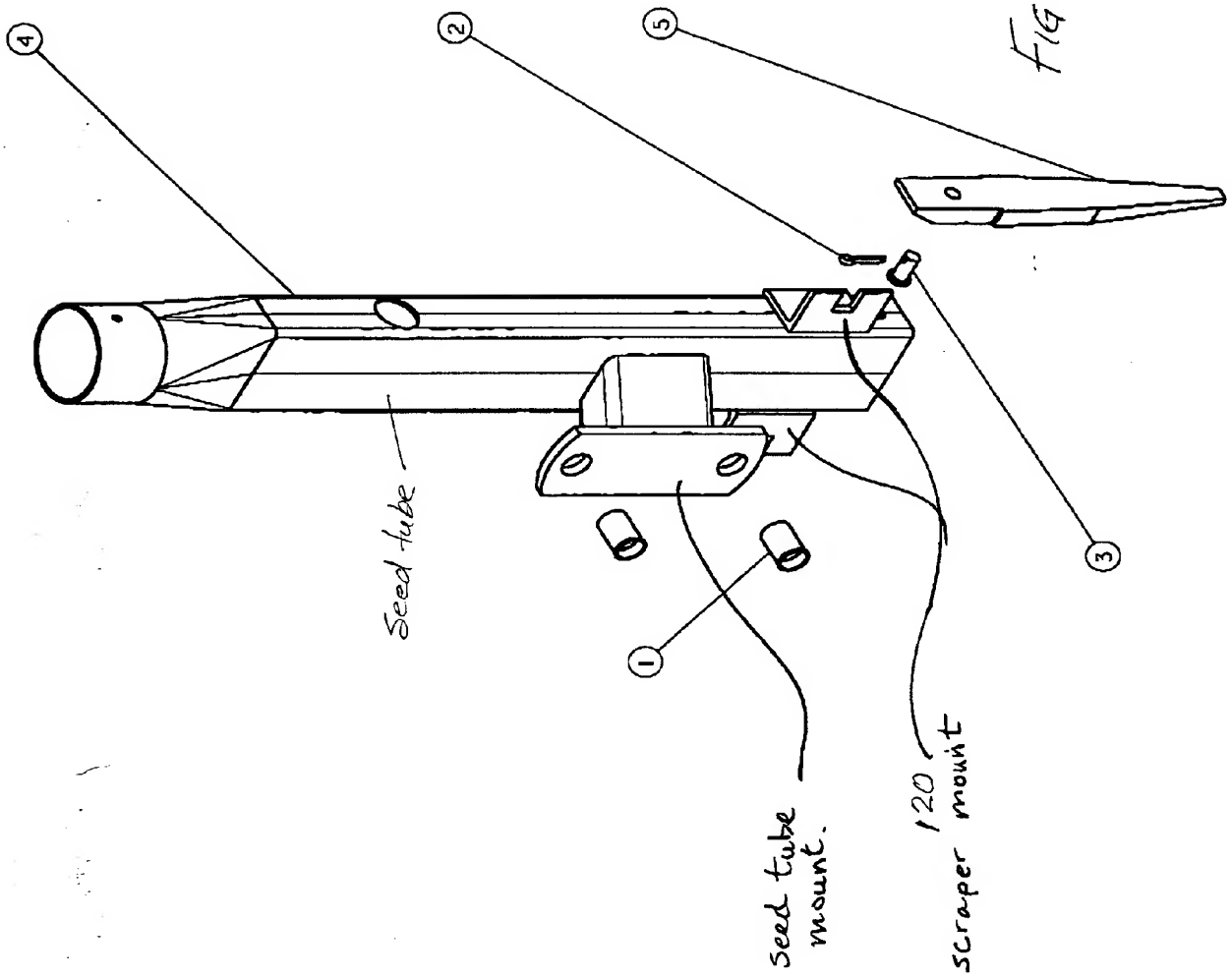


FIG 2.4

fig 3.1

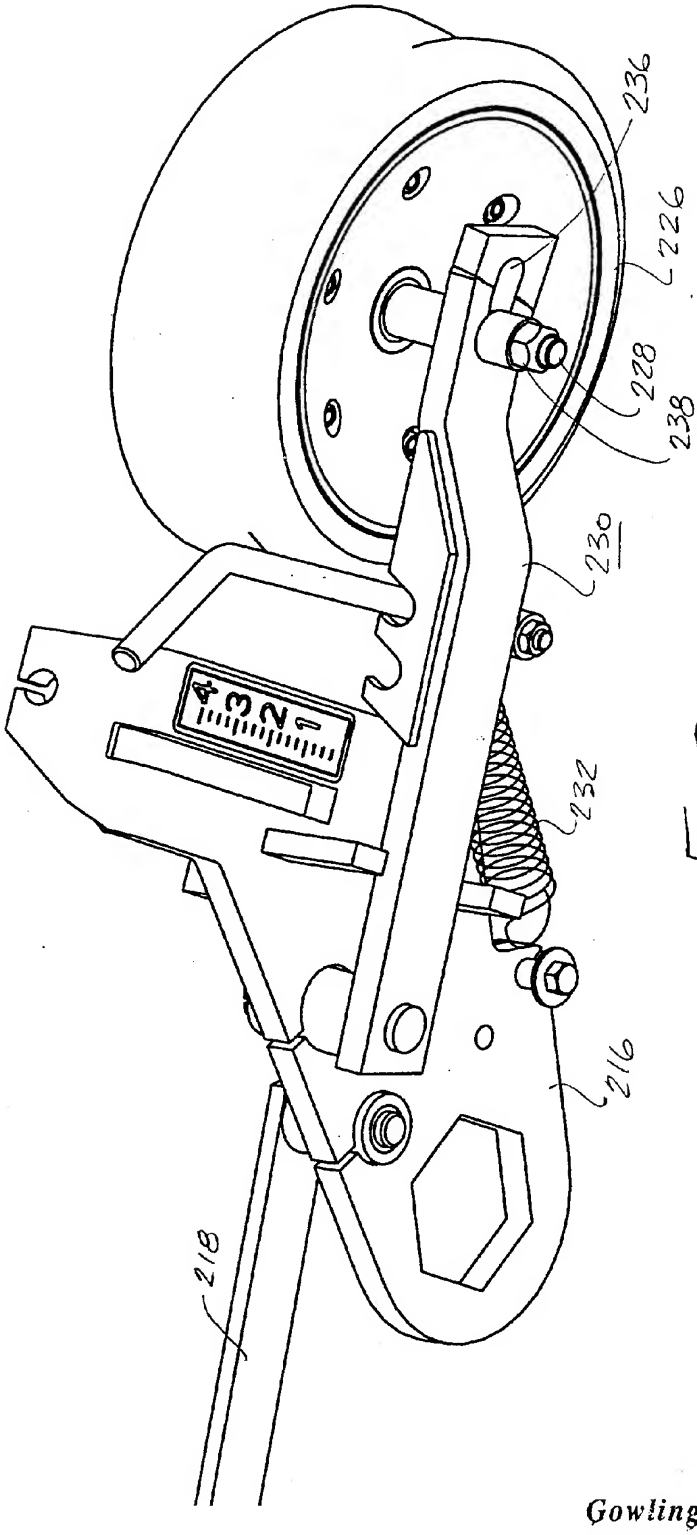


FIG. 3.1

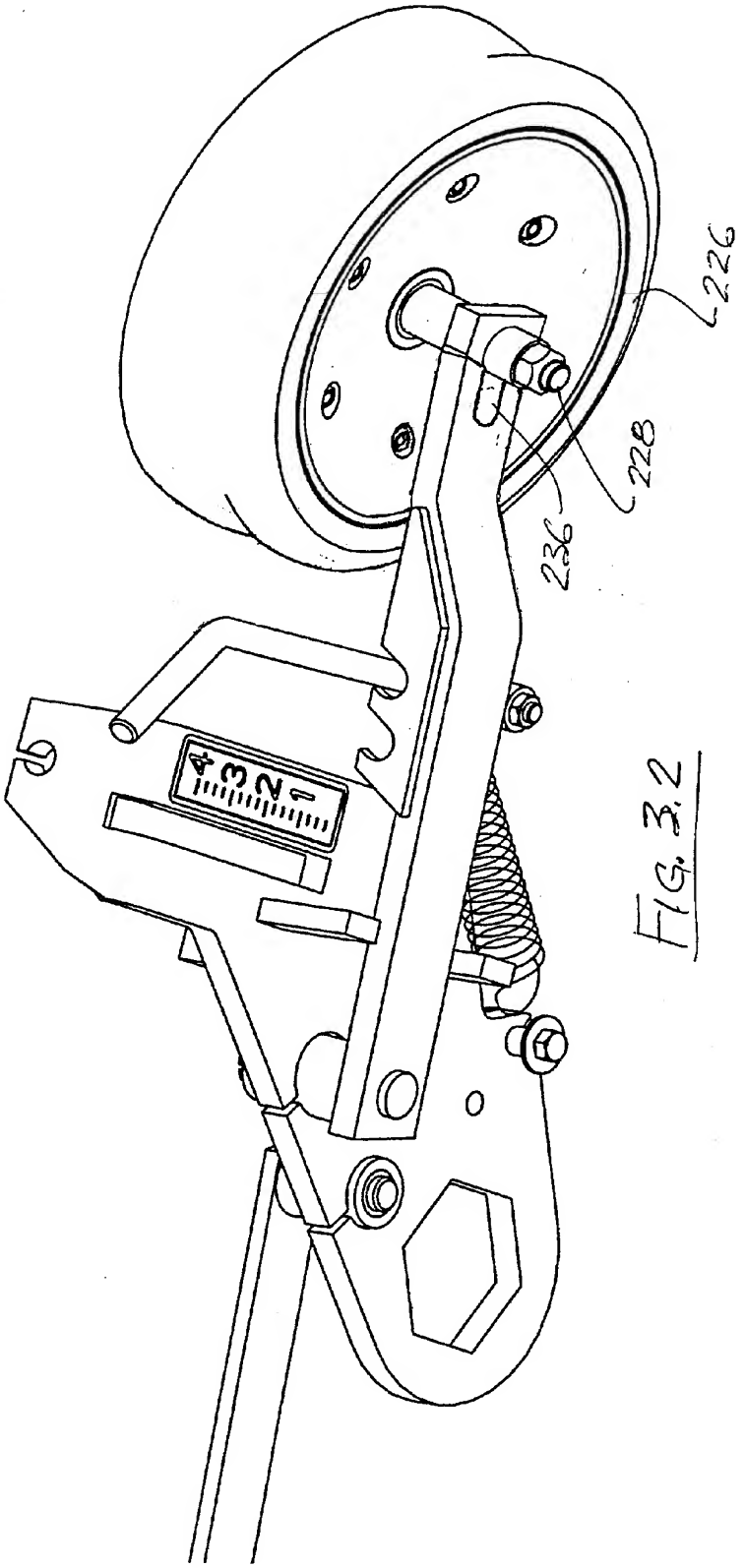


FIG. 3.2

fig 3.2

Fig 3.3

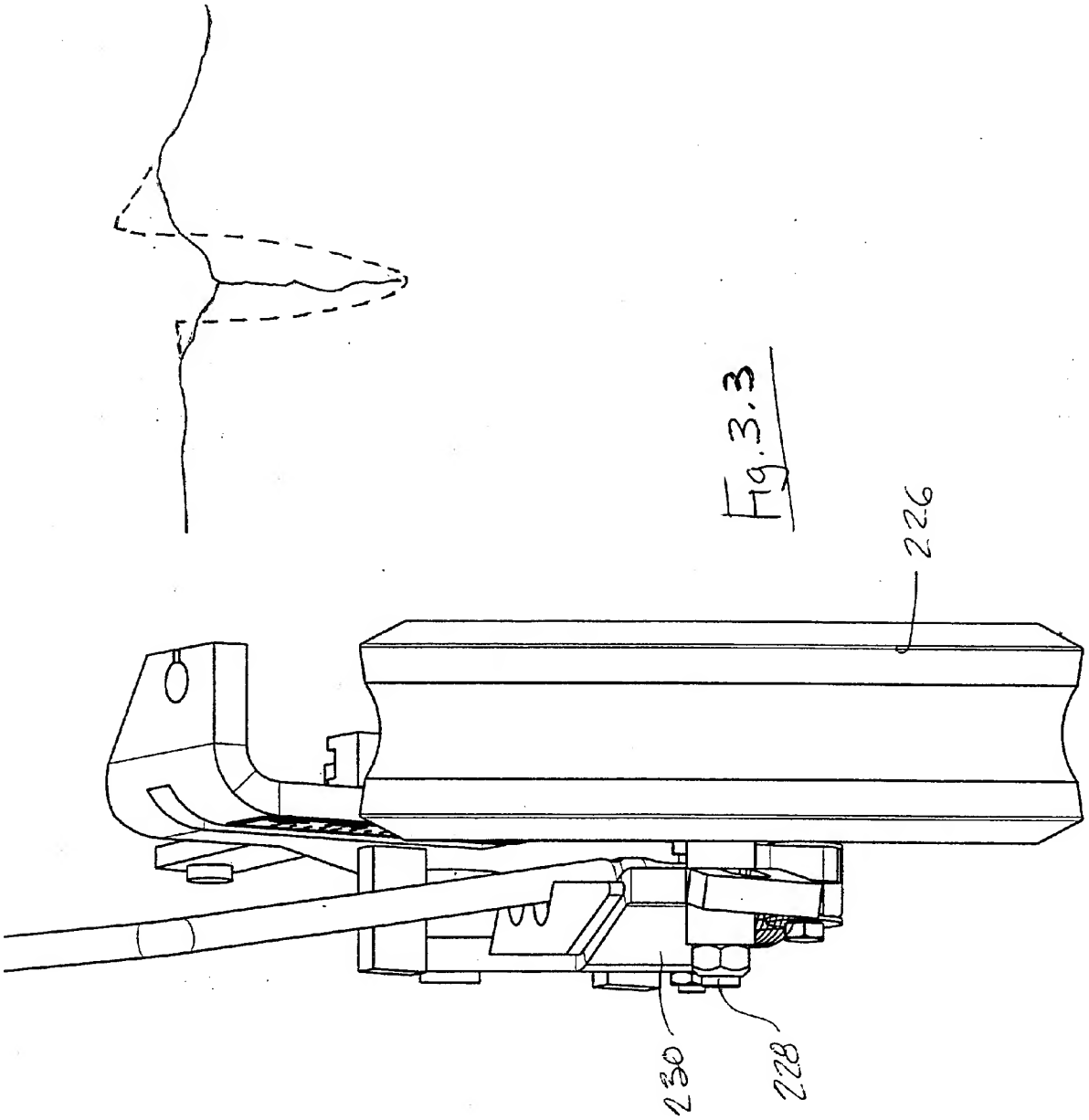


Fig. 3.3

Fig 3.4.

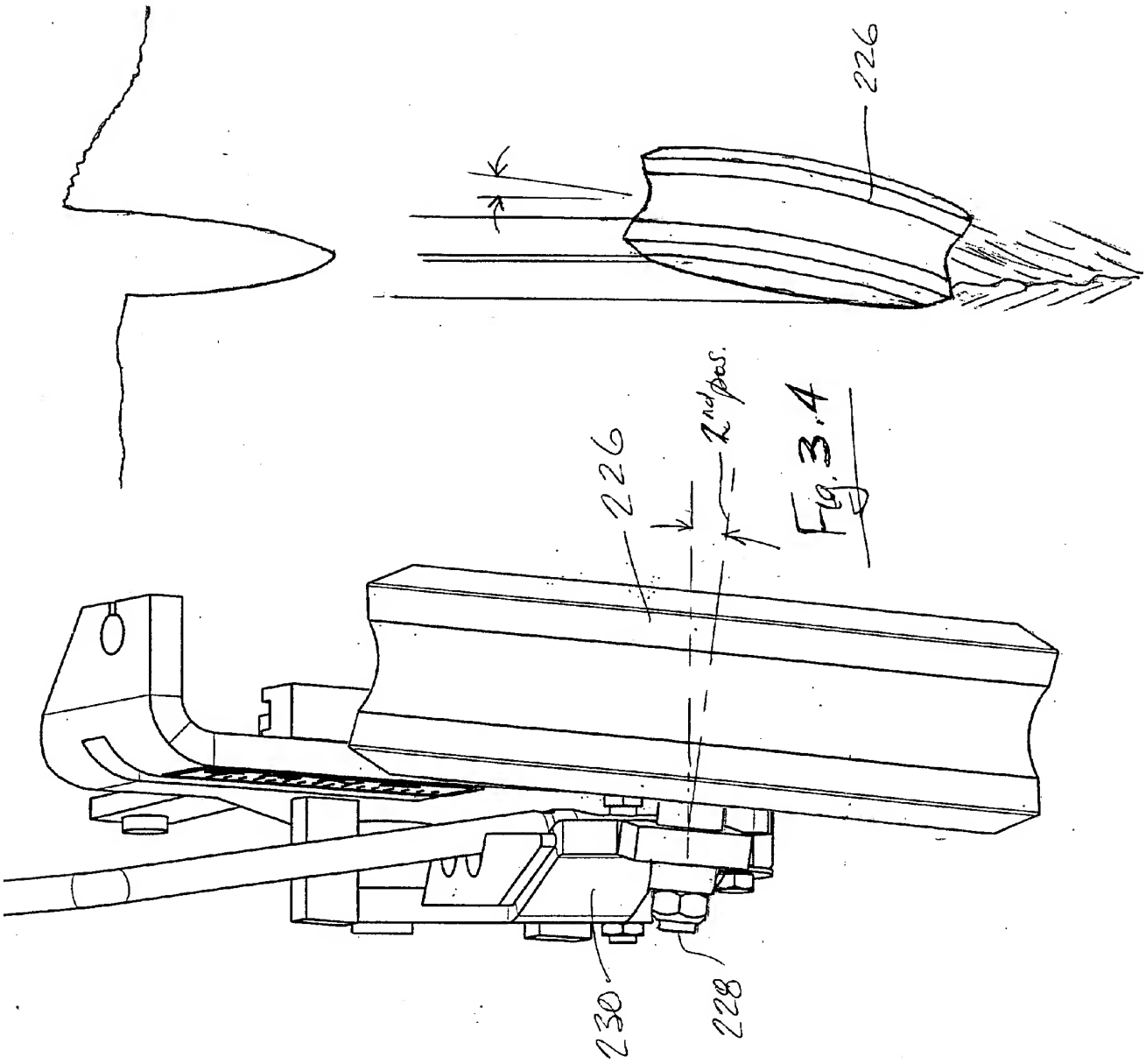


Fig. 3.4